

Estimate of the Wakefield Generated with the Beam from the New AWA Gun

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The new electron gun is under construction. Based on simulation results, this gun is capable of producing 100 nC bunches with physical emittance of 200 mm-mrad and rms pulse length of 1 mm. It is also designed to generate a train of 4 electron bunches with total charge up to 400 nC. The beam energy from the gun is 10 MeV. We can focus this beam into a small but short dielectric channel to obtain the high gradient. I have made some estimates of the wakefield amplitude by using this beam and the results are very encouraging. I believe we could easily access gradients of 200 MV/m using a single beam and 800 MV/m using all four bunches. The Figure below shows the result:

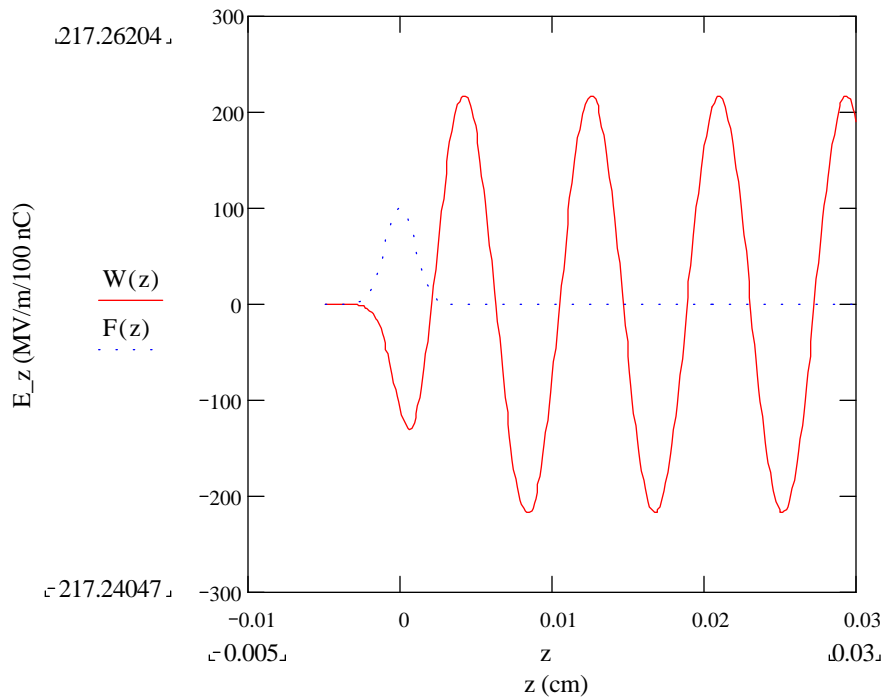


Figure 1: The wakefield excitation of a single beam in a structure with $a=2$ mm and $b=3$ mm and dielectric constant of 4.5 (Cordierite). The excitation frequency is roughly 30 GHz. We could easily excite more than 200 MV/m gradient by using multiple drive bunches. With four consecutive 100 nC bunches, the gradient would simply add up to 800 MV/m.

Based on the above arguments, I think we should perform this experiment right after the gun is conditioned. The beam line would be relatively simple to construct: a drift section and a quad triplet (both of which we already have).